CAN MUSIC HELP ATHLETES MANAGE PAIN DURING AN ICING TASK? AN EXPERIMENTAL TEST

by

Brittany Prijatel

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STATEMENT OF THESIS APPROVAL

The thesis of **Brittany Prijatel**

has been approved by the following supervisory committee members:

Leslie William Podlog	, Chair	**3/8/16** Date Approved
Maria Newton	, Member	**3/8/16** Date Approved
Craig Switzler	, Member	**2/27/16** Date Approved

and by **Janet M. Shaw** , Chair/Dean of

the Department/College/School of **Exercise and Sport Science**

and by David B. Kieda, Dean of The Graduate School.

ABSTRACT

Pain is ubiquitous in sport. Prolonged or reoccurring pain can lead to a host of negative consequences (e.g., isolation from teammates, feelings of anxiety, decreases in motivation). Previous research has examined how to decrease the perception of pain through psychological interventions (i.e., imagery, relaxation, and goal-setting). However, sport medicine professionals have indicated time constraints and lack of proficiency as barriers when implementing psychological interventions in the scope of a practice. Therefore, alternative techniques may be necessary. Research suggests that music is a safe, convenient, and easily implemented intervention. The purpose of this study was to investigate the use of music as a pain management intervention with collegiate athletes during an icing exercise. Using a repeated measure within subjects design, 50 athletes underwent an icing exercise once with preselected music and once without music. Perceptions of pain were measured prior to the application of ice, at five minutes, and at eight minutes after the application of ice. Additionally, assessments of relaxation, attentiveness to pain, and music enjoyment were collected at the end of both sessions. Hypothesis one stated that pain in the music condition would be less than pain in the no-music condition. No differences in pain emerged between conditions. Hypothesis two stated that athletes' pain in the no music condition would increase across time and athletes' pain in the music condition would decrease across time. There was a significant difference in baseline to 5 min pain scores within the no-music condition (χ^2

(2) = 8.011, p = .018). Relaxation and attentiveness to pain scores had relatively low impact on pain perception (R^2 = .034). Based on the results, there are no distinct conclusions as to which variable contributed most to the prediction of pain. Previous research has indicated that participants' enjoyment of music is a key factor when assessing pain. Consistent with previous research, a supplemental data analysis revealed significant impact of music enjoyment for the prediction of pain accounting for 10.6% of the explained variance (β = -.325, p = .021). These findings generate limited support for the use of music as a pain management intervention with athletes.

My thesis is dedicated to my family, friends, and faculty who supported me through this process.

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INTRODUCTION

Icing is the most commonly prescribed treatment for reducing swelling in musculoskeletal injuries for athletes (Knight, Brucker, Stoneman, & Rubley, 2000). Furthermore, athletes utilize icing for immediate care, recovery from the strains of training, as well as for injury prevention (Knight et al., 2000). While icing is considered an analgesic, it can also be a source of discomfort. Knight and colleagues (2000) reported that athletes acknowledge pain and discomfort during icing—particularly in the initial five minutes of exposure.

While athletes routinely deal with pain, it has been found that the discomfort associated with pain may preclude many athletes from engaging in and adhering to this essential injury prevention or recovery task (Daly, Brewer, Van Raalte, Petitpas, & Sklar, 1995; Ditor, Latimer, Ginis, Arbour, McCartney, & Hicks, 2003; Pen & Fisher, 1994). For example, Medina-Mirapeix, Escolar-Reina, Gascon-Canovas, Montilla-Herrador, and Collins (2009), found that patients with chronic neck or lower back pain were less likely to adhere to home exercise programs for more painful exercises.

Given the importance of icing and the difficulties many athletes have in undertaking and/or adhering to this important treatment modality, finding strategies to help athletes manage the pain associated with icing is critical for rehabilitation efforts and injury prevention measures. Towards this end, psychology of sport injury researchers, have examined the efficacy of a number of psychological interventions for pain management. Several interventions including: relaxation, guided imagery, goal-setting, and self-talk have proven efficacious in helping athletes reduce or manage their pain (Cupal & Brewer, 2001; Potter & Grove, 1999). For example, in their experimental study, Cupal and Brewer (2001) used relaxation and guided imagery to help athletes manage their postsurgical pain following an anterior cruciate ligament (ACL) reconstruction. Results indicated that participants in the guided imagery group experienced lower pain perceptions and a decrease in fear of reinjury. In another experimental investigation, Potter and Grove (1999) investigated the impact of psychological skills training, such as goal setting, relaxation, mental imagery, and positive self-talk on pain control for athletes in a physiotherapy setting. A four person randomized case study was designed to measure the impact of the mental skills training on pain intensity. Athletes who received the psychological skills training reported that goal setting, a more action oriented intervention, was most beneficial in reducing pain intensity at the end of the intervention period.

The previous studies highlight the benefits of psychological skill interventions for pain management and/or reducing pain perceptions among injured athletes. Along with improvements in physical pain, previous research has highlighted the psychological benefits that result from psychological skill interventions. Interventions such as self-talk, goal setting, relaxation, and imagery have reduced psychological consequences of injury and improved psychological coping. Psychological consequences consist of symptoms related to depression, anxiety, restlessness, and feelings of distress. Among others, increases in psychological coping skills consist of improved mood, self-efficacy, mindfulness, and perceived social support (Evans & Hardy, 2002; Johnson, 2000; Mahoney & Hanrahan, 2011; Mankad & Gordon, 2010; Reese, Pittsinger, & Yang, 2012; Rock & Jones, 2002). Also, Theodorakis, Beneca, Mailliou, and Goudas (1997) examined the effectiveness of goal setting in particular on performance. Results demonstrated an improved performance of injured student athletes. Furthermore, student athletes who specifically set performance goals towards isokinetic strength training, rehabilitation sessions improved performance more than injured athletes without performance goals. The previous studies highlight the benefit of psychological interventions for injured athletes for pain management, psychological coping, and improved performance. However, such interventions may be optimized when delivered by sport psychologists and/or sport medicine professionals with relevant knowledge and training. Furthermore, sport medicine practitioners have reported that time constraints may be a barrier in implementing psychological skills within the confines of a rehabilitation session (Arvinen-Barrow & Walker, 2013). These limitations, suggest the need for pain management interventions that do not require specialized training or substantial time investments before, during, or after a rehabilitation session.

One pain management technique that may meet the above criteria and which many athletes already use is music. Growing bodies of evidence highlights the beneficial effects of music for helping athletes achieve greater relaxation, enhanced motivation, and emotion regulation (Lane, Davis, & Devonport, 2011; Laukka & Quick, 2011). For example, Laukka and Quick (2011) surveyed athletes to find out the motives as to when and why they incorporate music into their sport. Results revealed that athletes used music in pregame and warm up to increase positive affective states such as alertness, confidence, and happiness, as well as increases in motivation. Similarly, Lane, Davis, and Devonport (2011) found that athletes who were given the opportunity to listen to music during a cardio workout had significant increases in positive emotive regulative purposes. More specifically, athletes reported increases in pleasant emotions and decreases in unpleasant emotions.

While music has been shown to optimize athletes' psychological status, the effects of music for the purposes of pain management, had yet to be empirically explored in an athletic population. There is however, a fairly substantial body of literature demonstrating the beneficial effects of music in helping individuals suffering a variety of pain conditions. Music therapy has shown to be effective in decreasing pain among post-operative cancer patients, pregnant women, and critical care patients (Ebneshahidi & Mohenseni 2008; Liu, Chang, & Chen, 2010; Lopez-Cepero Andrada et al., 2004; Menegazzi et al., 1991, Sen et al., 2010; Siedlieckı & Good, 2006; Tan, Yowler, Super, & Fratianne, 2010; Zımmerman et al., 1989). For example, in a study examining postoperative pain among 126 cancer patients, Huang, Good and Zauszniewski (2010) found that experimental group patients listening to a 30-min self-selected music session experienced significantly less pain than the bed rest control group. Two studies have also been conducted examining music and pain in a physical therapy setting (Bellieni et al., 2013; Ferguson & Voll, 2014). For instance, Bellieni et al., (2013) examined the effects of self-selected music on pain perception during a single physical therapy session. Results from their repeated measures design revealed that patients reported having lower ratings of pain after therapy sessions with music compared to therapy sessions without.

Additionally, when examining the effectiveness of music interventions researchers have highlighted findings regarding participants enjoyment of music. Regardless of the qualities of the music, previous research has demonstrated that music enjoyment is a key factor in reducing pain perception such that enjoyable music may shift one's attention away from a painful stimulus (Anshel, & Marisi, 1978; Davis & Thaut, 1989; Stratton & Zalanowski, 1984). In fact, Holden and Holden (2013) researched the beliefs of 318 sufferers of chronic pain and found music enjoyment to be one of the larger factors of pain reduction, along side other factors of relaxation and distraction. Collectively, the aforementioned studies suggest that music has beneficial effects for pain reduction among individuals suffering a host of physical conditions and ailments.

A number of limitations to the research on music and pain control are, however, noteworthy. First, of the few studies examining music and pain in a physical therapy setting, none have examined the benefits of music for managing pain in relation to an isolated treatment modality – for example, a single icing session. Rather, researchers have examined the effects of music for pain experienced over the course of an entire physical therapy session (e.g., Bellieni et al., 2013). Given that icing is commonly employed by athletes for a range of prevention and recovery needs, understanding the influence of music on athletes' ability to manage pain while experiencing this particular treatment modality, is of clear significance. A second limitation to previous research on music and pain is the lack of investigation into the mechanisms by which music affects pain perceptions. While researchers have suggested that music may alleviate pain through attentional distraction or via somatic relaxation (Bellieni et al., 2013; Holden & Holden, 2012; Mitchell & Macdonald, 2006; Nilsson, 2008), the means by which music helps to reduce pain remains uncertain. Assuming, music helps athletes to manage their pain, it is important to determine the extent to which such effects occur through alterations in attentional focus or through the promotion of relaxed physical/somatic states. Presently, the relative contribution of attentional distraction versus somatic relaxation to pain control efforts through music remains uncertain.

In summary, it is apparent that athletes may struggle to manage the pain associated with icing tasks, a fact which may prevent them from engaging in this important treatment modality. It is also evident that current psychological interventions (e.g., imagery, relaxation) may be most effective when implemented by experts with relevant training and expertise. Furthermore, it is apparent that music – something many athletes already use − may be an easily implemented intervention that helps athletes control pain while engaged in essential icing exercises as well as other potentially painful recovery exercises. Having experimental evidence of this would have clear implications and/or benefits for research and practice. In particular, having an intervention that is easy to administer can make for a more practical pain management strategy, one that can facilitate athletes' ability to self-regulate their pain management. Secondly, understanding the means by which music affects pain reduction (i.e., via attentional focus or physical/somatic relaxation) will clarify the role that music plays in potentially reducing pain during a commonly employed therapeutic treatment modality – icing.

Given (a) the absence of research examining the effects of music for pain management in an athletic population, (b) the limitations of previous research on music and pain management, and (c) the potential benefits of music for pain management during a commonly employed therapeutic treatment (icing), the purpose of the current within-subjects experimental study is threefold. The first aim was to compare the effect of music versus no-music on athletes' acute pain perceptions while undergoing an icing protocol. Consistent with previous research, it was hypothesized that when participants were in the experimental (music) condition they would report less pain than when participants were in the no-music control condition. Secondly, I hypothesized that athletes' pain within the music condition would decrease from baseline to eight minutes, and conversely athletes' pain within the no-music condition would increase from baseline to eight minutes. Additionally, assuming music plays a significant role in reducing pain associated with icing, the second purpose was to examine the relative contribution of attentional focus versus somatic relaxation in reducing pain. Given the dearth of previous research on the mechanisms by which music may reduce pain, no specific hypotheses were forwarded in relation to the second purpose. Lastly, the third aim of the current investigation was to examine the effect of music enjoyment towards the prediction of pain. Given evidence suggesting the value of the enjoyment of music when assessing pain, the current study will take into account athletes' enjoyment of the preselected music during the icing exercise.

METHODS

Participants

Athletes from the University of Utah (Division I) were contacted via email and/or phone in order to recruit participants. Any male or female athletes between the ages of 18-30, and uninjured at the time of study participation were eligible for study involvement. Athletes were excluded from study participation if they had experienced a musculoskeletal injury either during recruitment or after admittance into the study. An injury was defined as any muscle, tendon, bone, joint, or ligament damage that resulted in the participant taking medication, having surgery, or consulting a physician, for pain that stopped or reduced usual physical activity for at least one day (Hootman, Macera, Ainsworth, Addy, Martin, & Blair, 2002). The rational for selecting healthy athletes was to minimize potential confounding effects of variables such as injury type or severity on athletes' pain perceptions during the icing task. An a priori G*power analysis revealed that 44 participants needed to be recruited for the study given an alpha of .05, power of .8, and effect size of .25 (Faul, Erdfelder, & Lang, 2007). To ensure an adequate sample was collected, 50 participants were recruited to account for possible attrition.

Measures

In addition to assessing basic demographic information (age, gender, sport type, injury history), athletes completed the Visual Analog Scale (Clarke & Spear, 1964) to examine their pain perceptions during the icing task. In order to assess athletes' level of relaxation, the Smith Relaxation States Inventory (Smith, 2001) was administered. Next, attentional focus was assessed using the Pain Vigilance and Awareness questionnaire (McCracken, 1997). Finally, participants' expectation and enjoyment of music selection was examined using a one-item likert type question.

Pain

The Visual Analog Scale (VAS) was used to measure pain. The VAS was originally developed to measure well-being, but it has since been adapted to measure pain (Aitken, 1969; Clarke & Spear, 1964). Woodforde and Merskey (1972) first reported use of the VAS pain scale in patients with a diversity of medical illnesses such as chronic hepatitis C, arthritis, and diabetes. The Visual Analog Pain Scale is a one-item measure of perceived pain. The VAS measures intensity of pain on a scale of 0-100 mm, with 0 indicating, "no pain" and 100 indicating, "pain as bad as it could be." Participants simply marked a vertical line so that it was perpendicular to the scale indicating how intense they perceived pain to be at that moment in time. The VAS has demonstrated internal consistency (α =. 94) (Gallagher, Biiur, Latimer, & Silver, 2001) and construct validity. The VAS has been shown to be highly correlated with a numeric rating scale as opposed to a verbal descriptive scale, using response options ranging from "no pain" to "pain as bad as it could be" with correlations ranging from 0.71-0.78 (Hawker, Mian, Kendzerska, & French, 2011).

Relaxation

The Smith Relaxation States Inventory 3 (SRSI3) was utilized to measure relaxation. The SRSI3 is an extended version of the original Smith Relaxation States Inventory (Smith, 2001). The aim of the SRSI3 inventory is to assess relaxation states, divided into four dimensions: basic relaxation, mindfulness, positive energy, and transcendence. For the current study, only the basic relaxation subscale was utilized, as the aim was to capture participants' overall relaxation levels during the icing task. The SRSI3 basic relaxation subscale is composed of 11 items assessing: sleepiness, disengagement, physical relaxation, feeling rested/refreshed, and mental relaxation. The statement stem asked participants to focus on the present moment (i.e., "Right now, I feel …"), with items ranked on a Likert-type scale from 1 "not at all" to 6 "maximum". Sample items included "My hands, arms, or legs, are SO RELAXED that they feel WARM and HEAVY" and "I feel at ease." Relaxation scores was the sum of the 11 basic relaxation items. The SRSI has shown adequate internal consistency ($\alpha = .72$ to $.90$) (Smith, 2001). The SRSI3 basic relaxation dimension has been correlated with previous versions of the Smith Relaxation States Inventory, providing evidence of criterion validity for the SRSI3 (Groncheh & Smith, 2004; Smith, 2001).

Attentional Focus

The Pain Vigilance and Awareness Questionnaire (PVAQ) was used to measure attentional focus. Attention to pain may positively or negatively influence pain perception and pain severity (McCracken, 1997). The PVAQ is designed to capture awareness, vigilance, preoccupation, and observation of pain. The PVAQ is a 16 item questionnaire which asked participants to rate responses on a Likert-type scale from 0 (never) to 5 (always). The PVAQ has demonstrated adequate internal consistency ($\alpha = .86$) and has shown evidence of convergent validity with PVAQ scores being positively related to private body consciousness ($r = .58$) and negatively correlated with ignoring pain from the coping strategies questionnaire ($r = -.24$). For the purpose of this study, the stem was modified to indicate: "During icing…" (e.g., "…I am very sensitive to pain"). Sample items included: "I am very sensitive to pain", "I am quick to notice changes in pain intensity, and "I pay close attention to pain."

Enjoyment

The enjoyment question is a one- item likert type question to gauge the participants' enjoyment of the music implemented during the intervention. The question was phrased as such: "How much did you enjoy the music that you listened to during the icing task?" Ratings were on a likert type scale from 1 (very unenjoyable) to 5 (very enjoyable). The enjoyment question aided in the interpretation of pain, relaxation, and attentiveness scores reported by athletes throughout the study.

Procedure

Upon consent from the athletes' themselves, participants were asked to schedule a meeting with either the principle investigator or the head athletic trainer to receive information regarding the inclusion and exclusion criteria, details of the study, aims and procedures, potential risks of involvement, as well as dress code instructions. Per a repeated measures design athletes were enrolled for both study conditions, therefore, athletes participated in the icing exercise twice. Participants were asked to report to the University of Utah athletic training room per their scheduled appointment time for all data collection. Following informed consent procedures, athletes were given an ID number. The athletes were randomly assigned to the experimental group (group A) or the control group (group B) as their first condition. To conclude the initial portion of the meeting each participant was given the demographic information sheet to fill out prior to the start of the study.

Upon arrival the PI or other athletic training staff member verified with the participant that the electronic device in which the music was used to elicit music was working properly (experimental condition only). The device was then confirmed to have enough battery life to last the duration of the icing task, that is 20 min, so the athletes were able to listen for the entire duration of the study. The PI or athletic training staff briefly refreshed the participants on the order of events during the icing exercise. Prior to the start of the icing exercise, athletes were given instructions to sit silently during the experiment as to not confound the data collection process. Before the icing exercise began the premeasure for pain (VAS) survey was administered. Additionally, the one item likert type expectation question was administered. After completion of the surveys (approximately 1 min or less) the PI or athletic training staff member collected the surveys and placed it in a file folder to be stored in a locked filing cabinet.

Each subject was then instructed to change into the necessary clothing (shorts) to ensure the ice came in direct contact with participant's skin. Next, the participants were instructed to sit while the athletic training staff wraped ice to the back of the right knee. At that moment time was recorded. Once time started, athletes reporting for the music session listened to preselected "top 40" music for the duration of the icing session at a self-selected volume through a set of headphones. Preselected music was administered in order to control for variability in music selection, such that each athlete received the same music and was able to rate their responses on the administered questionnaires based on the same criterion. Athletes reporting for the no-music control condition sat quietly for the duration of the session in the icing exercise. At exactly the 5-min mark participants were given the single-item VAS in which they marked a vertical line so that it was perpendicular on the visual scale, thus indicating their pain level. The purpose of administering the VAS at the 5-min mark was to assess pain level while participants were engaged in the icing task, when pain was likely to be at its highest level. To account for variability among participants in pain tolerance, another VAS was administered at the 8-min mark to measure pain. This measure of pain at the 8-min mark would serve as the "post" pain measure. Participants continued icing for the last 12 min. At the 20- min mark participants were instructed to take off the ice bag and to complete the SRSI-3 and the PVAQ. Both group A and group B were instructed to complete the SRSI-3 and the PVAQ at the end of the icing exercise so as to not interfere in any way with the effect that listening to music or having no music could have on personal ratings of pain, relaxation, and distraction. Additionally, when participants completed the music condition, they were asked to complete a one item response on their enjoyment of the music. Participants were thanked for completing the study and instructed to consult an athletic trainer or other staff member to address any other needs if necessary.

Following data collection procedures, surveys were collected and stored in a secured filing cabinet. Surveys were grouped together with an ID number, but not with names to keep confidentiality.

Data Analysis

Following the completion of the icing sessions, data was entered in SPSS for further analysis. The data was 100% screened and cleaned to check for any missing data. All data was referred to by ID numbers in order to maintain confidentiality. Five separate analyses were conducted to examine the aforementioned purposes of the study. Before conducting the primary analyses, two nonparametric Mann-Whitney U tests were used to examine the potential confounding effect of order. Tests of order effects were necessary to see if pain was dependent on when the athletes received the conditions. Specifically, baseline pain scores of athletes who underwent the music condition first were tested against baseline pain scores of athletes who received the music condition second. Conversely, baseline pain scores of athletes who underwent the no-music condition first were tested against baseline pain scores of athletes who received the no-music condition second.

The main analyses consisted of both a between condition analysis and a within-condition analysis. In relation to the between condition analysis, comparing all of the music pain scores against all of the non-music pain scores, three nonparametric dependent t-tests were run to test hypothesis one: athletes' pain in the music condition would be less than athletes' pain in the control condition. Next, two separate nonparametric Friedman tests were performed in order to test hypothesis two, that athletes' pain within the music condition would decrease from baseline to eight minutes, and athletes' pain within the no music condition would increase from baseline to eight minutes. This analysis examined within condition effects by comparing athletes' pain across time (baseline, 5 min, 8 min) in each of the conditions (music across time and nonmusic across time). Each of the Friedman's tests were followed by posthoc nonparametric analyses to indicate where significant changes in pain scores occurred across the measured time points.

Prior to examining the relative contribution of relaxation and or distraction, two dependent t-tests were employed to test any significant differences in relaxation and attentiveness scores between when athletes were in the music condition and when athletes were in the no music condition. To more closely investigate the role of the relaxation and attentiveness to pain variables, a multiple regression analysis was conducted to examine the relative contribution of distraction and relaxation regarding pain perception. Previous research has indicated that music enjoyment can play a role in diminishing unwanted negative outcomes such as pain and discomfort. As such, the one item likert type question regarding the athletes' enjoyment of music during the icing exercise was regressed on to perceived pain. Statistical significance for each analysis was set (α =. 05) to protect against type 1 error.

RESULTS

In this section, I will discuss the results for the main analyses conducted to test the hypotheses in the given project. Prior to the analyses, assumptions of normality and order effects are explained. Dependent t-tests assessed hypothesis one: pain in the music condition would be less than pain in the no-music condition. In regard to the second and third analyses, two nonparametric Friedman's tests with posthoc analyses were implemented to test hypothesis two. Hypothesis two stated that when participants were in the music condition they would experience a decrease in pain from baseline to eight minutes; and when participants were in the no-music condition, they would experience an increase in pain from baseline to eight minutes. Lastly, a regression was conducted to test hypothesis three: the relative contribution to which relaxation and or distraction contributes to the prediction of pain. In addition to the analyses, supporting graphs and figures are provided.

Preliminary Analyses

Before conducting the primary analyses, assumptions of normality were tested via the Shapiro-Wilk test. Results from the pain scores revealed that this assumption was violated, and therefore nonparametric statistical tests were employed in subsequent analyses. However, scores from the relaxation and attentiveness to pain measures met the assumptions of normality, therefore parametric tests were used to test hypothesis three. Following the assumptions testing, order effects were tested between the two conditions (music and no-music) at baseline using the Mann-Whitney U independent t-test. As such, each t-test was not significant (music: $Z = -.606$, $p = .545$; non-music: $Z = -1.607$, $p = .108$) indicating that pain scores were not dependent on the order in which the participants received the music condition. With nonsignificant order effects the data was combined by condition (i.e., music/ no music).

To characterize the data, means, and standard deviations for each dependent variable within the music and no-music condition were calculated. As shown in Table 1, athletes experienced relatively similar pain between music and no-music conditions with large variability among the pain scores. Additionally, it is noted that the majority of the pain scores fell between the 0-50 mm mark on the VAS, with very few scores extending past mid-point. In general, athletes' pain scores increased from baseline to the 5-min mark and decreased from the 5-min mark to the 8-min mark as demonstrated by the progression of pain scores in Figure 1.

Pain Results

The primary analyses, testing hypothesis one, utilized a between condition analysis. Namely, three nonparametric dependent Wilcoxon signed rank t-tests based on scores reported from the VAS. The t-tests compared the difference in median scores (due to a nonparametric dispersion) between music and no-music conditions at the three time points. For example, the first dependent t-test compared pain at baseline between the music condition scores and the no-music condition scores. The t-test at baseline yielded a nonsignificant result ($Z = -.249$, $p > .05$), suggesting the groups reported similar levels of pain. The additional Wilcoxon signed rank t-tests showed that when athletes listened to music, it did not elicit statistically significant change in pain levels at the five-minute time point (Z = -1.191, p >.05) and at the eight-minute time point (Z = -1.101, p > .05) as compared to when they did not listen to music. Due to non-significant findings between conditions, hypothesis one was not supported.

The second analysis, testing hypothesis two used a within-condition analysis. Hypothesis two stated that athletes' pain within the music condition would decrease from baseline to eight minutes, and conversely athletes' pain within the no-music condition would increase from baseline to eight minutes. Pain across time within each condition was examined separately. In other words, differences in pain within the music condition across time were examined. The same strategy was used in the no-music condition. Thus, two separate analyses using Friedman's tests were performed. Consistent with the previous analyses, nonparametric tests were implemented for hypothesis two. The Friedman's test is the nonparametric equivalent to a one-way repeated measures ANOVA. The first Friedman test assessed pain experienced by athletes when they were in the music condition from baseline to the eight-minute mark. The second Friedman test assessed pain experienced by athletes when they were in the no-music condition from baseline to the eight-minute mark. The first Friedman test revealed a significant difference among pain scores within the music condition χ^2 (2) = 6.741, p = .034. In order to identify where the significant change occurred, a posthoc analysis using the Wilcoxon signed rank tests was conducted with a Bonferroni correction applied, resulting in the significance level being set at p < 0.017. There was a significant decrease in pain scores from the five-minute mark to the eight-minute mark within the music condition (Z = -3.40, p = .001).

The second Friedman test also yielded significant results within the no music condition, $\chi^2(2) = 8.011$, $p = .018$. Follow up analysis using the Wilcoxon signed rank tests was conducted, again adding a Bonferroni correction, resulting in significance level being set at $p < 0.017$. There was a statistically significant increase in pain from the baseline to five-minute mark ($Z = -2.726$, $p = .006$), as well as a statistically significant decrease in pain from the five-minute mark to the eight minute mark ($Z = -2.806$, $p = .005$). Hypothesis two was partially supported in that the music condition experienced a decrease in pain from minute five to minute eight. Furthermore, the no-music condition experienced elevated pain from baseline to the 5-min time point. Contrary to predictions, the no-music condition reported less pain from minute five to minute eight. Given the results of these analyses, pain related hypotheses are partially supported.

Relaxation and Attentional Awareness Results

As noted above, participants in the present study were also tested on relaxation and attentional awareness measures in order to facilitate interpretation of any differences in pain that might emerge. However, no significant differences were apparent between either relaxation or attentional awareness scores when listening to music or in the no-music control condition. The data for all comparisons are summarized in Table 1. On average, the relaxation scores were higher when athletes were in the music condition compared to when they were in the no-music condition. Additionally, participants had lower attentional awareness during the music condition as opposed to during the no-music condition. Each of these differences is slight, but nothing definitive emerged. Two dependent t-tests revealed no significant mean differences between relaxation or attentional awareness scores ($t(49) = .349$, $p > .05$; $t(49) = .150$, $p > .05$), respectively.

Exploratory Analysis

As for the exploratory analyses, two linear regressions were conducted. The first regression tested the independent contribution of the relaxation and attentional awareness variables with relation to pain scores. The overall regression model was nonsignificant, demonstrating it was not different than zero $F(2, 47) = .823$, $p > .05$. In short, the regression model does not predict pain scores well ($R^2 = .034$). This result indicates that relaxation and attentional awareness accounted for only three percent of the variance in pain scores. To further understand the relationship between the independent variables (relaxation and distraction) and the dependent variable (pain), a Pearson product-moment correlation coefficient was computed. As such, there was no correlation between either of the variables. Relaxation: r = -.127, n = 50, $p > .05$; attentiveness to pain: r = .121, n = 50, $p > .05$. With nonsignificant predictors the data are not supportive of any distinct conclusions on which variable contributed more to pain prediction at this time. The second regression measured the contribution of athletes' enjoyment of the music to the prediction of pain. A linear regression established that music enjoyment could statistically significantly predict pain $F(1, 48) = 5.67$, $p = .021$ and music enjoyment accounted for 10.6% of the explained variability in pain ($\beta = -.325$, $p = .021$). The regression equation demonstrated that as ratings of enjoyment increased by 1 unit, pain decreased by 5.198 units.

Table 1
Means and SD's of Variables

	Music		No Music	
Test	M	SD	M	SD
SRS	2.72	.76	2.67	.87
PVAQ	2.03	.67	2.10	.73
Baseline Pain	13.76	17.88	12.60	16.93
5-Minute Pain	17.83	16.61	20.50	20.15
8-Minute Pain	12.41	14.74	15.46	17.44

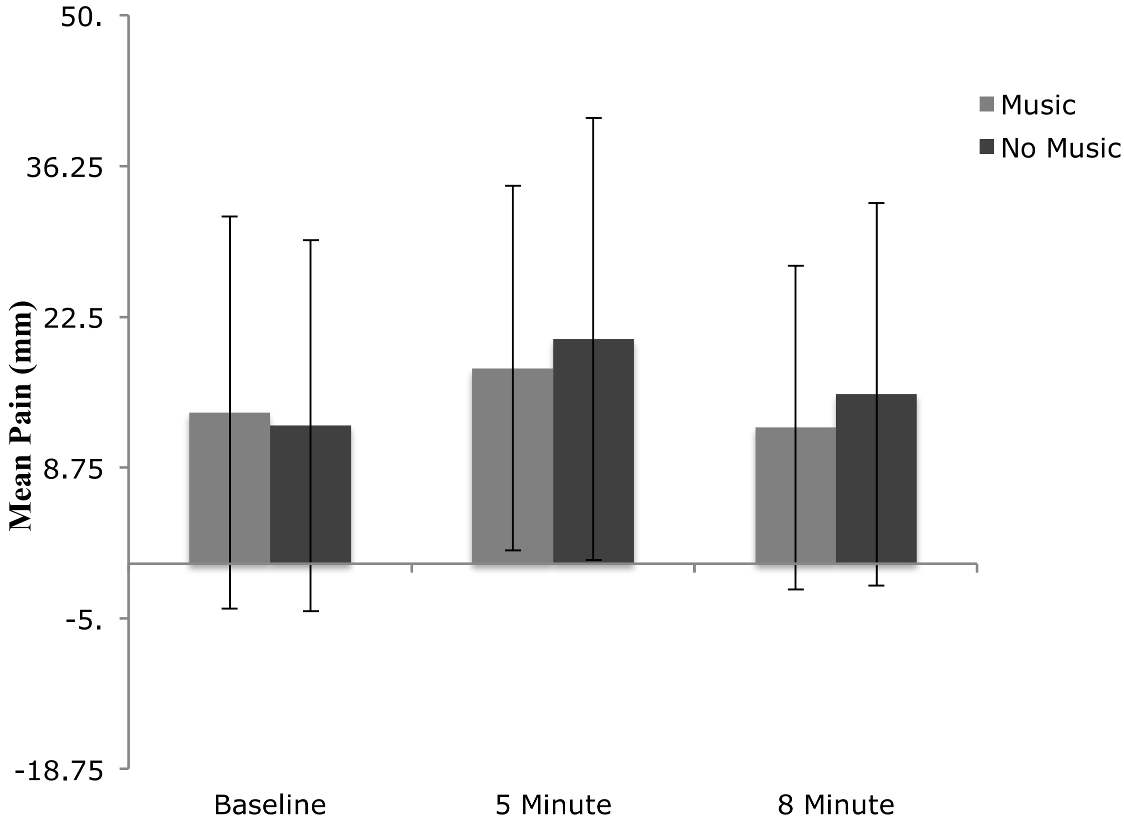

Figure 1. Pain across time in music and non-music conditions.

DISCUSSION

This study used a repeated measure within subjects design to address potential within-person differences in pain, relaxation, and attentional awareness while undergoing a music treatment condition and a no-music control condition. In the present study, there was not a significant difference in athletes' pain scores between conditions. Additionally, there was not a significant predictor of pain among the independent variables of attentiveness to pain and relaxation. Although, significant differences in pain were observed while participants were in the no-music control condition, the current study extended previous research findings by examining the relationship between athletes' pain level while adding an exposure to music, as well as investigating the relationship between relaxation and distraction when utilizing music as an analgesic.

Pain

The pain scores reported throughout the experiment partially supported the main hypothesis. Although there was not a significant difference of pain scores between music and no-music conditions, there was a significant difference in pain scores within the no music condition. Since there were no significant differences in pain between conditions, a test of within subjects provided additional information of what music was doing across time. A follow-up repeated measure ANOVA was used to interpret findings within the no-music condition across time. From the baseline measure of pain to the five-minute measure of pain, participants experienced a significant increase in pain. So, although the beneficial effects of music may not be demonstrated within the findings, when music was withheld participants did experience increases in pain. The overall development in the pain scores was indicative of results that could support the use of music as a pain reducing technique. When exposed to a painful stimulus while in the music condition, reports of pain were slightly stunted, while the reverse was true when athletes were in the no-music control condition. After five minutes, reports of pain decreased slightly, which is expected as the athletes were approaching the numb sensation, as identified by Knight, Brucker, Stoneman, and Rubley, 2000. Although there was no support for differences between conditions, the trend demonstrated in the results is headed in the right direction.

Based on the pain responses given by the athletes, there are several possible explanations for these results. It may be that the actual icing exercise was comparatively innocuous to their usual sport-related pain. It is also likely that current study lacked in adequate or sufficient power to detect significant differences between the two conditions. Research has been indistinct when it comes to the effectiveness of icing or the use of cryotherapy for inducing pain. Although dated, Turk, Meichenbaum, and Genest (1983) advocated cold pressure procedures as the most closely related exercise to clinical pain. However, more recent studies have suggested that the use of cold pressure exercises may be relatively ineffective for inducing pain with athletes who experience it frequently as a part of sport participation (Sullivan et al., 2008). One additional suggestion for these findings is associated with pain beliefs. Researchers have suggested that informing participants of the duration of a painful exercise may produce lower ratings of pain versus when the duration was withheld from the participants. The belief that pain will be enduring can produce greater subjective pain intensity regardless of the actual pain duration (Williams & Thorn, 1986, 1989). It is difficult to say whether informing participants of the duration that they would be icing significantly impacted their pain responses in the current study, although it does provide interesting insight on the importance of athletes' expectations and beliefs. Additional attention and measurement of athletes' current use of coping mechanisms when faced with a potentially painful event may be important to measure to fully understand their perceptions of a pain experience. It has been previously demonstrated that individuals who use more coping strategies are more confident in their own ability to manage or control pain (Keefe et al., 1997).

Further findings stem from the extent to which participant's enjoyment of the music affected the perception of pain. A supplementary regression was implemented in order to test the effect of music enjoyment for the prediction of pain. Several studies indicate that whether participants enjoy the music or not may influence pain perceptions. Data analysis revealed that as athletes' enjoyment increased by one unit, their level of pain decreased about five units. This finding supports previous research that participants' enjoyment of music impacts the amount of pain experienced (Anshel & Marisi, 1978; Laukka & Quick, 2011). Despite limited support when comparing pain scores between the conditions, these findings suggest the potential value of music as a pain management technique with athletes. Interestingly enough, researchers have identified that certain qualities of music can have an influence on an individual's preference of music during exercise. Findings indicate that factors such as tempo, pacing, rhythm, resonance, and harmony can create an optimal listening experience. It is for these reasons that music allows an individual to cope with specific exercises/modalities that may evoke feelings of pain (Karageorghis & Priest, 2011; Priest & Karageorghis, 2008).

Relaxation and Distraction

In previous research, music has shown beneficial effects on participants' relaxation levels and as distraction in helping to cope with pain (Holden & Holden, 2012; Mitchell & MacDonald, 2006; Saalfield, 2008). Although research has yet to look at which variable may be more predictive of pain reduction. Therefore, the second aim of the study was to examine the relative contribution of relaxation and/or attentional awareness/distraction to the prediction of pain management. Upon analysis, the findings of this study were not congruent with previous research, which found that music could be relaxing and distracting when participants undergo a painful exercise. There was very little difference between the relaxation coefficients and the attentiveness to pain coefficients within the music condition. This finding, in part, could be due to the insignificant finding among the pain measures because of the underlying assumption demonstrating music's pain-relieving qualities. As much as there is to know about music and its effects on the body (i.e., motivation, ratings of perceived exertion, mood). There is little that is known about the most efficacious form(s) of music in terms of creating the most optimal pain relieving experience. However, concepts and models in response to pain within relaxation and distraction research will be discussed.

Pain research points to several factors that may affect an individual's experience to painful stimuli. One factor in particular is managing what we attend to or focus on during sensations of pain. Implementing techniques that may limit the focus of an individual's attention on negative stimuli such as pain with an external stimulus such as music has been suggested. For instance, Rajeski (1985) proposed the Parallel Processing Model (PPM), which posits that the external stimulus such as music can distract a person from painful exercises by drawing attention to the music itself. One caveat as discussed by Tenenbaum and colleagues (2004) is that once painful sensations exceed the distraction capability of the external stimulus (perceptual threshold), individuals will then attune or shift their attention to internal sensations of pain or fatigue or exertion. A key factor in this equation as demonstrated by Anshel and Marisi (1978) is whether participants enjoyed the music. It is thought that enjoyable music may change an individual's attention away from a potential painful situation. With relation to the present study's findings, it could be that athletes who did not enjoy the music during the icing exercise were more aware of sensations of pain. Athletes who did not enjoy the music might then have experienced heightened sensations of pain because that is where their attention could have been directed.

Data analysis indicated no significant differences in relaxation scores when athletes were in the music or the no-music conditions. These findings do not support previous research advocating for the use of music as a coping method. Although previous research indicates that music has been found to have relaxing qualities, which they have utilized and adopted in both sport and nonsport settings. Originally, medical facilities incorporated music into waiting rooms and offices in order to promote relaxation for these potentially anxiety-provoking situations (Ferguson & Voll, 2004). Additionally, Laukka and Quick (2011) researched how athletes are using music in sport. Athletes indicated that uses of music were quite purposeful in order to positively impact their training and or performance. Within that same study, one of the most frequently cited uses of music was to feel calm and relaxed. From an injury rehabilitation standpoint, a relaxed body allows for a more fluid muscle and joint movement, which can promote a positive healing process. One alternative explanation for the current findings is the possibility that music may have the potential to have both relaxing and distracting effect for individuals. Due to the subjective nature of pain and even music, attempting to pinpoint specific interactions may be difficult. Additionally, it has previously been discussed that attention can be variable, so listeners may fluctuate between relaxed or distracted states.

Limitations and Future Directions

There are limitations in the present study that can help with interpretation and generalization of the findings. While sample size was limited, the trend demonstrated in reported pain scores is indicative that the relationship between music and pain reduction was headed in the right direction. As such, it can be hypothesized that a reason for limited variability in pain scores was due to a lower intensity pain exercise. The selection of the icing exercise may have essentially been too limiting in order to create a significantly painful response among athletes. Therefore, selection and utilization of an adequately painful exercise should be handled with careful consideration. The difficulty in developing a painful exercise that encapsulates athletes of all strengths must be accounted for upon consideration. Pain research is limited by the difficulty of the implementation or creation of a realistic painful experience relevant to sport. There has been attention given to the fact that pain induced in controlled lab settings differs extensively from pain that might be experienced during certain aspects of sport involvement. For example, during a controlled lab setting, athletes are aware that no injury will result from the pain experience (Sullivan et al., 2008), such as icing. Additionally, while preselected music adds controllability and structure to a study it lacks in creating an optimal pain-reducing environment for athletes. Some autonomy in music choice and or selection has demonstrated to be somewhat beneficial as opposed to preselected music in a host of positive sport outcomes such as increased effort and reduce ratings of perceived exertion (Karageorghis & Priest, 2011). Giving individuals the power to choose has beneficial implications in dealing with pain as well. Podlog, Dimmick, and Miller (2011) discussed how autonomy during rehabilitation can be beneficial for injured athletes, in addition to providing practical suggestions of specific situations in which athletic trainers and sports medicine professionals can implement these techniques.

The understanding that pain is ubiquitous for all athletes gives researchers a platform to implement and improve past and current techniques. Understanding that athletes will experience pain in some manner or domain is a basic requirement for pain research. Future lines of research should look to implement pain management techniques in various situations when an athlete may experience pain. For example, implementation in preseason conditioning workouts, to the physiological stresses of continuous competition while in season, or even during rehabilitation after serious injury and return to sport protocols. Also, standardization of implementation of a music intervention is lacking in current research, which creates limited ability to compare findings among previous research. Music research might benefit from a uniform methodology when delivering music studies and interventions. While research has identified a conceptual model of some unique and various characteristics of motivational music (Karageorghis & Terry, 2009), there is little information on what defining qualities about music that creates pain-relieving effects. Furthermore, one additional aim echoed by multiple researchers is the attempt to be more theoretically based with current research (Beck, 1991; Good et al., 1999; Perlini & Viita, 1996). Theoretical grounding provides more than an historical context with which to frame research, it also provides a more narrowed and polished approach to view future research questions. A theoretical framework may provide some cohesion between current music research, which currently lacks structure and methodological similarities. Music can be an easily implementable pain management technique that athletes are already using for other sport and physical activity related purposes. However, given the absence of research on music and pain management with athletes, more research is necessary to fully understand the effects of music on athlete pain perceptions.

Conclusions

The purpose of the present study was to evaluate the effectiveness of a music intervention for the reduction of pain perception. In general athletes reported a slight reduction of pain when listening to music as compared to when they were not listening to music. Further research with larger samples is needed to increase the likelihood of detecting reliable differences between music and no-music conditions. Yet, there is no conclusive evidence that music significantly impacted athletes' pain perceptions during this icing exercise. It was demonstrated that pain perceptions were dependent on whether the athletes' enjoyed the music during the icing exercise. This finding is an important factor in the consideration of practical implementation of music for the use of pain.

The second purpose of the current study was to investigate if music was used as a distracting coping mechanism or as a relaxing coping mechanism. Research has suggested that the qualities of music can have the effect of both relaxation and distraction, although no definitive conclusions can be drawn from the present investigation. More support for the use of music for the alleviation of pain is necessary within the athletic population to allow for practical implementation in various athletic training/sports medicine domains.

APPENDIX A

EXTENDED LITERATURE REVIEW

Pain is ubiquitous among athletes and other populations (Heil & Podlog, 2012). Not only is pain common, it is also problematic in terms of its consequences. For example, individuals going through pain have experienced increases in psychological distress, increases in anxiety, and even decreases in motivation. Given these problems a number of pain management strategies have been implemented to try and reduce pain and its associated consequences. This review includes four sections. First, I will outline a definition of pain and describe its various elements. Second, the review will provide a more detailed description of the consequences of pain among a variety of populations. Third, effective pain management strategies throughout pain management research will be described, and finally, suggestions for further research will be articulated.

Definition and Elements of Pain

The pain experience is overwhelmingly subjective in nature respective to each individual (Melzack & Katz, 2001). Given this underlining premise, defining "pain" is a complex task, lending to a multifaceted approach to understanding pain and its elements. Pawlak (2013) attempted to demonstrate the diversity of pain with respect to how it can be categorized. This approach uses three different criteria: (1) site of origin, (2) site of perception, and (3) duration. The purpose of the present section is to review each of these origins in further detail.

The primary categorization of pain is the site of origin, which is further broken down into physiological or pathological. Physiological pain is often characterized as either somatic or visceral pain. Additionally, somatic pain can be further described as superficial or deep pain. Somatic pain refers to pain from the muscles, joints, skin, or bones (Lewis, 1938). Visceral pain originates from organs inside the body. As previously mentioned, somatic pain can be either a superficial or deep pain. Superficial pain is known to be sharp, well-defined, and clearly located, whereas deep pain is a dull, aching, and poorly localized pain. To illustrate the difference, an example of a superficial somatic pain would be a first-degree burn. An example of a deep somatic pain would be more related to a sprain or a broken bone.

After the origin of pain is determined, the second characterization is the site of perception, or, according to the area. In the area in which pain is perceived, pain may be described as either generalized or localized. Generalized pain is in reference to pain that is not limited to a certain body part, whereas localized pain refers to pain that affects one or more parts of the body. Once the origin and area are identified, researchers look to the length of time that an individual has been experiencing the alleged pain.

Pain duration is categorized as either short-term acute pain or long-term chronic pain. The primary function of acute pain is informative in nature. Acute pain notifies an individual of maximal load on the body often warning or signaling potential injury or disease. Acute pain encourages rest in order to promote recovery. More importantly, acute pain motivates us to act in order to terminate such pain (Katz, Rosenbloom, & Fashler, 2015). It was not until relatively recently that the scientific journal *Pain* produced a standardized definition for this sensory experience through the International Association for the Study of Pain (IASP). Pain was characterized as an “unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage” (Bonica, 1979). Conversely, chronic pain causes distress. Unlike short term pain, no agreed upon definition of chronic pain has been shown throughout research. A standardized definition that is representative of all of the elements of persistent pain has yet to be accepted. For example, one prominent factor in which traditional conceptualizations of chronic pain has been in reference to “time,” because it is a distinguishing characteristic in comparison to acute pain. However, a time-based approach may fail to account for other relevant factors. For the purposes of research a few definitions have been formed. The IASP recognizes: “A persistent pain that is not amendable, as a rule, to treatments based upon specific remedies” as one of the current definitions for chronic pain (Katz, Rosenbloom, & Fashler, 2015). In order for researchers to define pain relevant to specific study interests, knowing how pain will be measured within a study can direct or influence how researchers characterize pain.

Pain has been measured in many different dimensions dependent on specific research interests. Common forms include both unidimensional and multidimensional measures of pain. The typical focus of unidimensional scales is that of pain intensity. Multidimensional scales focus on additional aspects of the pain experience. Noting just a few, scales aim to measure the sensory, affective, and evaluative aspects of pain and or pain intensity (Hawker, Mian, Kendzerska, & French, 2011). Relative to the multifaceted approach, pain can be assessed with regards to location, duration, and origin (Pawlak, 2013). Yet, given the subjective nature of the pain experience, interpretation of pain ratings still creates difficulty in generalization and application of research findings.

As researchers strive to understand and interpret the pain experience in its entirety, we see other elements of pain begin to be incorporated throughout research. Not only is the stimulus of pain important, but also the interpretation of such stimulus. Part of the pain experience is one's interpretation of the painful sensation or stimuli. Two important characteristics of pain that can be measured are pain threshold and pain tolerance. Pain threshold may be defined as the amount of a certain stimulus that will just barely produce a painful sensation under given conditions (Hardy, Wolff, & Goodell, 1943). Put more simply, pain threshold is when an individual first indicates a stimulus as painful. Pain tolerance, on the other hand, is traditionally defined as the amount of noxious stimulation that a person is willing to endure (Gelfand, 1964). As with many variables of interest, the differing effects of the pain experience have been documented by researchers.

Effects of Pain

Pain has been shown to have enduring physical, psychological, and inhibitive implications on individuals (Sullivan, Tripp, Rodgers, & Stanish, 2000). The component that generates recognition of a painful sensation is the perception of pain. Perception of pain is typically triggered by a harmful stimulus (i.e., an injury or disease) (Loeser & Melzack, 1999). When the human body endures such pain, our main goal is to return to homeostasis if possible. The current section will discuss the physical and psychological symptoms associated with pain, as well as the inhibitive repercussions of pain and discussed among some notable populations.

Pain by its nature is in part a physical phenomenon and therefore it is not surprising that it has been shown to have a range of deleterious implications for the body as whole. Melzack and Wall (1965) first attempted to offer an explanation towards the physiology of pain perception using the gate control theory of pain. In short, the gate control theory of pain posits that as painful stimuli are generated at injured sites on the body, they encounter “neurological gates” at the spinal cord, which ultimately determines if the pain signals should reach the central nervous system or not (Melzack & Wall, 1965). Yet, as complex as the human body is, pain, in its many forms has the ability to create a discomfort to individuals. Pain typically creates limitations to our daily activities. These physical limitations include but are not limited to: range of motion, tenderness, soreness, strength, functionality, and recovery (Lichtenstein, Dhanda, Cornell, Escalante, & Hazuda, 1998). Additionally, there are situations in which pain can be present even with the absence of noxious stimulus. For example, the despair one might experience from the loss of a loved one (Gould, 2007). Another type of pain that is more non-traditional is called neuropathic pain. Neuropathic pain is when nerves transmit pain signals from the site of injury are suddenly activated. Neuropathic pain often occurs due to injury to the brain, spinal cord, or the peripheral nerves (Gould, 2007). Often times, individuals suffering from neuropathic pain lack visible evidence to corroborate the complaint and standard pain medicine are inefficient in combating these sensations, which may only worsen the effects. Simply from the few aforementioned examples discussed, the extent to which pain can affect the body physically varies. Addison, Kremer, and Bell (1998) attempted to further understand the effects of pain and how athletes then respond to that pain. The taxonomy of pain provides a continuum to describe the 6 progressive levels of pain within a sport setting. Fatigue and discomfort relate to normal or typical sensations associated with competition, training, or rehabilitation. Positive training pain refers to nonthreatening, normally occurring during endurance activities and believed to be under control. Negative training pain is perceived as threatening and an indicator that continual training might not be beneficial. Negative warning pain is more threatening than negative training pain, usually indicating potential injury and prompting an athlete to examine the cause and take necessary action. Negative acute pain is a sign of injury and is perceived as intense and specific. Numbness is the absence of sensation; this feeling is viewed as highly damaging and cause for concern (Addison, Kremer, & Bell, 1998).

Pain has also been shown to have detrimental implications on an otherwise healthy psychological function. A colloquial term associated with pain in the medical field is suffering. Cassell (1982) states that suffering occurs when the physical and or psychological boundary of an individual is threatened. Suffering is a negative response to stimulus that is induced by feelings of pain (Loeser & Melzack, 1999). In some cases, physical pain and suffering may lead to increased negative psychological symptoms. For instance, feelings of fear, stress, anxiety, or anger have all been reported in relation to a specific painful experience. More specifically, in situations where surgeries or operations were necessary to reduce or eradicate pain, physical marks such as scarring can serve as a reminder of such pain. Thus, provoking negative feelings of anxiety or self-consciousness (Brown, McKenna, Siddhi, McGrouther, & Bayat, 2008; Gilmartin, 2007). A more serious point of interest is the effect that pain has on an individual overtime. Ill-managed acute pain can easily lead to chronic pain (Wells, Pasero, & McCaffery, 2008). Chronic pain is also known to have enduring psychological consequences. Individuals dealing with prolonged pain have a tendency to see fluctuations in other well-being factors such as anxiety, feelings of isolation, distress, isolation, and a loss in motivation (Breivlk, Collett, Ventafridda, Cohen, & Gallacher, 2006; Engle, 1959; Schwarts, Temkin, Jurado, Lim, Heifets, Polepalli, & Malenka, 2014). Additionally, patients with chronic pain have demonstrated to have the highest levels of depression (Feldman, Downey, & Schaffer-Neitz, 1999; Gupta, 1986; Kerns, Rosenberg, & Jacob 1994; Linton & Gotestam, 1985). Pain, in both physical and the psychological sense, has the ability to produce enduring and damaging effects on one's quality of life. Often times, it has been demonstrated that feelings and perception of pain lead to other self-defeating behaviors.

Finally, pain has damaging and inhibitive repercussions as well. Individuals who experience pain go through an assortment of pain behaviors (Turk, Meichenbaum, & Genest, 1986). These behaviors might include something as simple and immediate as uttering "ouch" upon first perception of pain. Alternatively, pain behaviors in individuals who experience chronic pain can extend to something as drastic as the inability to work or complete tasks as efficiently as desired. Another negative related pain behavior is isolation from social interactions. Often times, individuals who experience frequent pain tend to withdraw from social situations, due to the discomfort of exposing the symptoms of their illness to other individuals (Bury, 1982; Strauss, 1975). It is common to see individuals who experience chronic pain to have a lowered or reduced sense of self-esteem, which only increases the desire to withdraw from usual social situations (Dysvik, Natvig, Eikeland, & Lindstrom, 2005). In addition, individuals in pain have more strained family and interpersonal interactions, because of the burden of having to constantly care for an individual with chronic illnesses such as rheumatoid arthritis, multiple sclerosis, cancer, and so forth. (Kerns, Haythornthwaite, Southwick, & Giller, 1990; Manne & Zautra, 2014; Sofaer-Bennett, Walker, Moore, Lamberty, Thorp, & O'Dwyer, 2007). The combination of both physical symptoms and psychological symptoms may lead to a wide range of pain related behaviors, some of which have been previously mentioned. As discussed, pain behaviors can have a negative impact on an individuals' overall well-being.

Pain and Athletes

Pain is a field of interest that has taken root in numerous populations. For example, pain and potential injury are common consequences of sport participation (Raudenbush, Canter, Corley, Grayhem, Koon, Lilley, Meyer, & Wilson, 2012). There has been a growing number of studies attempting to address the issues of pain in sport over the past few years. For instance, over two-thirds of the studies addressing pain and sport were published in the last ten years (Pawlak, 2013). At the peak level of competition, we have seen an increasing number of athletes willing to play through pain. For example, Nixon (1993) reported that an overwhelming 90% of athletes have admitted to continuing to play through pain and/or injury at some point in their collegiate career. Willingness to play through pain has been identified by athletes as a display of character building as well as a way to gain respect from others (Messner,1992; Nixon, 1993). More recently, Weinburg, Vernau, and Horn (2013) reported that both male and female basketball players with higher levels of athletic identity also reported a higher level of willingness to play through pain. In conjunction with willingness to play through pain, researchers have seen an increase in self-administered opioid usage. A study of retired NFL football players indicated that 52% used opioids during their career as a result of injury related pain (Cottler, Abdallah, Cummings, Barr, Banks, & Forchheimer, 2011). This finding has unfortunately filtered down to youth sports (Veliz, Boyd, & McCabe, 2013). Use of opioids for pain can easily lead to opioid misuse further impacting an athlete's willingness to play through pain. While eliminating athletes' willingness to play through pain and injury may not be a practical attempt, increasing the ability for an athlete to positively cope with pain during performance can have beneficial implications. The current section will focus on the differences of the pain experience between an athletic and a nonathletic population, as well as highlight suggestions behind these findings.

Athletes versus Nonathletes

When compared to nonathletic populations, researchers have identified that athletes encounter some differences throughout the pain experience. Typically, athletes and nonathletes have a similar pain threshold, however it has been shown that athletes have a different pain tolerance than nonathletes (Janal, Glusman, Kuhl & Clark, 1994; Jaremko, Silbert, & Mann, 1981; Raudenbush et al., 2012; Scott & Gijsbers, 1981; Tajet-Foxell & Rose 1995; Walker, 1971). A meta-analysis revealed sufficient backing in demonstrating the differences in pain threshold and pain tolerance between athletes and nonathletes across various pain studies (Tesarz, Schuster, Hartmann, Gerhardt, & Eich, 2012). While athletes and nonathletes have been found to have a similar pain threshold, there is currently no empirical evidence to explain this phenomenon. Research suggested that the aforementioned outcome might be due to athletes' constant exposure to pain. Athletes may have a better understanding of pain as well as a higher endurance for pain, consequently leading to a higher pain tolerance (Ryan & Kovacic, 1966). Additionally, it has been hypothesized that pain tolerance is more correlated with psychological factors as opposed to physiological factors, whereas pain threshold is more correlated to physiological factors than psychological factors (Gelfand 1964; Wolff 1964). Meaning, upon the initial experience of a painful sensation, there is a similar physiological reaction between athletes and nonathletes. Although, when it comes to enduring pain, athletes have made more use of coping mechanisms and psychological factors than nonathletes. Even within the athletic population past research has seen differences emerge. Among athletic populations, studies have revealed that contact and team sport athletes tolerate more pain than noncontact and individual sport athletes as well as nonathletes (Egan, 1987; Ryan & Foster, 1967; Ryan & Kovacic, 1966; Scott & Gijsbers, 1981). Weinberg, Vernau, and Horn (2013) expand on this finding noting an increased willingness and positive attitude to play through pain from athletes who had higher levels of athletic identity than lower levels. As demonstrated through the definition and elements of pain, the pain experience is quite individualized, so too are the ways in which athletes regulate their pain through such coping mechanisms.

Looking at pain within a range of populations can provide researchers with a better understanding of the effects of pain and potential solutions to help moderate pain and discomfort. For example, in 2002, adults who recently had surgery were contacted to report how much pain they experienced postsurgery. Among those participants, 80% of patients reported pain after surgery. Within that population 86% reported moderate, severe, or extreme pain (Apfelbaum, Chen, Mehta, & Gan, 2003). Comparatively, sports medicine physicians' report that pain is one of the most frequently cited problems observed among injured athletes (Brewer, Van Raalte, & Linder, 1991). Given the prevalence for pain and the growing pervasiveness of pain amongst multiple populations, it is important to have pain management techniques to help individuals cope with experiences of pain surrounding physical activity and or sport involvement. The following section will discuss pain management techniques among an athletic and nonathletic population.

Pain Management Techniques

A growing body of literature has focused on providing athletes with efficacious pain management techniques to assist with the reduction of pain perceptions. Such techniques including imagery, relaxation training, goal setting, self-talk, and many others have been beneficial in promoting pain management amongst athletes (Cupal, 1998; Potter & Grove, 1999; Reese, Pittsinger, & Yang, 2012). Existing techniques have been categorized into either cognitive or behavioral. Cognitive coping strategies consist of techniques in which the focus is to redirect attention away from pain or to reinterpret the pain experience (Williams & Kinney, 1991). Alternatively, behavioral coping strategies attempt to shift behavior in order to control pain (i.e., participating in prosocial behaviors such as socializing with friends). In the present section, I will discuss some of the most common mental skills training techniques that have been employed in previous research which have aided athletes and nonathletes in management of pain.

Imagery

A common mental skills technique utilized by researchers to alleviate pain is imagery. Loosely defined, imagery is the mental rehearsal of a task (Jeannerod, 1995). Additionally, imagery involves creating or recreating an experience using all of the senses (Vines, 1988). Imagery is often used for two primary purposes: cognitive and motivational. Cognitive imagery entails a mental rehearsal of specific tasks or skills that may be necessary for training or competition. Whereas motivational imagery typically focuses on imaging goals and aspirations associated with sport (Dreidiger, Hall, & Callow, 2006). Another capacity in which imagery is often used is during the rehabilitation process in the form of healing imagery. Healing imagery is the process of imaging physiological progressions back to the original state or to promote healing. (Dreiger, Hall, & Callow, 2006; Sordoni, Hall, & Forwell, 2000, 2002). The current section will provide information regarding the use of imagery in response to pain in both athletic and nonathletic populations.

Dreiger, Hall, and Callow (2006) looked to gain insight as to the ways in which injured athletes utilized imagery to cope with pain. Athletes engaged in various methods of imagery in order to manage pain. For example, one athlete described using imagery as a preparation mechanism. Meaning, that he imaged situations that which might be painful, as often times pain complements physical exercises, it then helped the athlete deal with those situations once they occurred. Other athletes utilized imagery as a distraction method from attending to pain postsurgery, and spent the time envisioning return to sport outcomes. A number of athletes simply used imagery to block the pain, by just letting their brain turn off for a little. Lastly, one athlete alluded to using imagery to control pain, in a sense of imaging the pain dispersing while receiving treatment. Each of the aforementioned methods provided relief for injured athletes coping with pain.

In order to address certain limitations to findings in existing research, Hare, Evans, and Callow (2008) and Evans, Hare, and Mullen (2006) conducted semi-structured interviews with injured athletes who used imagery across a rehabilitation regiment. Participants demonstrated the use of cognitive, motivation, and healing imagery throughout the course of physical therapy. Within the early phases of rehabilitation, participants employed imagery in order to cope with pain and promote healing, which further allowed one athlete to regulate anxiety levels. Hare et al., (2008) echoed these findings when conducting an interview with an elite athlete. As discussed in each article feelings of clarity, vividness, and control fluctuated throughout the rehabilitation process. For instance, one athlete indicated lack of clarity and control with imagery use gave in to "negative flashbacks" of the injury occurrence making it difficult to remain positive (Evans et al., 2006). Overall, there has been evidence that imagery has aided among the athletic population (Green 1992; Porter & Foster 1987).

Among nonathletic populations, imagery has been a useful tool in alleviating pain (Alden, Dale, & DeGood, 2001; Simonton, Simonton, & Creighton, 1984; Vines, 1988) Specifically, in cancer patients, discovered that patients receiving both an imagery and relaxation interventions had a significantly greater reduction in pain than the singular interventions and the control group (Syrjala, Cummings, & Donaldson, 1992a; Syrjala, Donaldson, Davis, Kippers, & Carr, 1995). Additionally, pain and psychological distress were noted to decrease following surgery for orthopedic injury and ACL reconstruction surgery (Baider, Uziely, & Kaplan De Nour, 1995; Cupal & Brewer, 2001; Ross & Berger, 1996).

Relaxation

A mental skills training technique that is particularly well versed in research is relaxation. Relaxation techniques aim to target two forms of relaxation: physical (somatic) and mental (cognitive) (Flint, 1998). The principal goal of physical relaxation is to rid the body of physical tension. Whereas, mental techniques hone in on the mind, supporting the concept that the body will follow a relaxed mind (Walker & Heaney, 2013). The current discussion will focus on different forms of relaxation techniques that have been developed in both athletic and nonathletic populations.

Relaxation techniques are among the most frequently suggested psychological coping skills for injured athletes (Heil, 1993; Taylor & Taylor, 1997). Relaxation techniques come in many forms. Current relaxation techniques that have demonstrated to be effective in alleviating, controlling, and assisting athletes in coping with pain are: progressive muscle relaxation (PMR), meditation, yoga, breath control, and autogenic training (Flint, 1998). I will first discuss the somatic relaxation techniques used, PMR, and breathing. Hill (2008) describes PMR as learning to tense and relax groups of muscles sequentially, while simultaneously keeping close attention to the feelings of tension and relaxation associated with the action. The idea behind this technique is that with enough practice the athlete will be able to relax rather quickly (Weinberg & Gould, 2011). Correct breathing is necessary to attaining a relaxed state, because it is linked with the body's physiological arousal system (Keable, 1989). For example, slow and steady breathing has stress-relieving properties that can produce effective technique for reducing stress, anxiety, and pain (Weinberg & Gould, 2011). The main cognitive relaxation technique used is meditation. Meditation utilizes a combination of elements to assist the individual to stay present. Meditation has been defined as voluntarily focusing attention on the present experience in its sensorial, mental, cognitive, and emotional aspects in a nonjudgmental way (Cottraux, 2007). One specialized technique used that incorporates a relaxation component is stress inoculation training (SIT). This technique will be discussed further in the discussion of relaxation techniques for nonathletic populations. However, injured athletes too have shown a decrement in pain when using relaxation techniques implemented within an SIT training program (Ross & Berger, 1996). More recently, Naoi and Ostrow (2008) implemented autogenic training coupled with breathing techniques for pain in which injured athletes benefitted during a rehabilitation session. As demonstrated multiple forms of relaxation techniques have been facilitative among athletic population.

Previous research has demonstrated the effectiveness of relaxation techniques for the alleviation of pain among a variety of nonathletic participants (Caroll & Seers, 1998; Jessup & Gallegos, 1994; Linton, 1994; Malone, & Strube, 1988; Owens & Ehrenreich, 1991). To note a few: Wilson (1998) found that postoperative patients who used Progressive Muscle Relaxation (PMR) decreased in pain, as compared to patients who did not use PMR experienced in increase in pain during initial physical therapy sessions. Similarly, patients with chronic lower back pain progressively exhibited lower physical pain when using a long term progressive muscle relaxation regiment (Embry, 2001). As mentioned previously, pain management research has seen positive results with the use of stress inoculation training. To expand further on the components of SIT, it is comprised of three phases: conceptualization, skill acquisition, and application. In the first phase, conceptualization, the participant is educated about stress and its elements as well as viewing stress as an opportunity rather than an obstacle. In the second phase, skill acquisition and coping skills are taught. In the final phase, application, the patient is given opportunities to practice the coping skills (Wells, Howard, Nowlin, & Vargas, 1986). Like their athletic counterparts, SIT has been found effective in dissolving pain given a number of populations including: burn patients, cancer patients, rheumatoid arthritis patients, and presurgical patients (Moore & Altmaier, 1981; Randich, 1992; Wells et al., 1986; Wernick, Jaremko, & Taylor, 1981).

Overall, it has been hypothesized that relaxation alleviates pain via: (a) reducing the demand for oxygen in the tissue and lowering levels of chemicals that can trigger pain; (b) releasing tension in the skeletal muscle that can diminish pain; and (c) releasing endorphins that act together with receptors in the brain to reduce perceptions of pain (McCaffery & Pasero, 1999). Relaxation techniques continue to develop and persist in the field of sport psychology and a host of other settings for the use of pain management.

Goal Setting

One of the more mainstream mental skills techniques is goal setting. Much of goal setting research is focused on creating effective goals. When creating goals it is advised that they be realistic, relevant, specific, and measurable (Kiresuk, Smith, Cardillo,1994; Wiese & Weiss, 1987). One vital characteristic to goal setting is that the individual needs to take the time to assess and reevaluate goals that have been previously set (Davis & White, 2008). In the current segment, I will discuss some of the common themes of the implementation of goal setting for pain management research both with athletes and other populations.

Using goal setting as a pain management technique has been beneficial among individuals attempting to manage acute as well as chronic pain (Caudill, 2002; Davis, & White, 2008; Pasero & McCaffery, 2003, 2004; Von Korff, Gruman, Schaefer, Curry, & Wagner, 1997). Also, occupational therapists commonly use goal setting as an agentive technique when helping patients manage chronic pain. One appealing element to goal setting for patients was the flexibility in the types of goals that are being set (e.g., take the dog for a walk every other day versus say three things to be grateful for at the end of each day) (Van Huet, Innes, & Stancliffe, 2013). As a result of continued research, goal setting has demonstrated to be a safe an effective technique that can be implemented with individuals who are experiencing persistent pain (Makris, Abrams, Gurland, Reid, 2014). As we have highlighted research on helpful pain management techniques among individuals suffering chronic pain, we now look to discuss the relevant research pertaining to sport.

Injured athletes have often implemented goal setting throughout rehabilitation to help curb feelings of pain and facilitate recovery (Cott & Finch, 1990; DePalma & DePalma, 1989; Ermler & Thomas, 1990; Smith, Scott, & Wiese, 1990; Weiss & Troxel, 1986; Worrell, 1992). Interestingly enough, when goal setting has been introduced as a mental skills training technique amongst a combination of others, often times there has been a preference for the utilization of goal setting over other techniques (Potter & Grove, 1999). This finding is consistent with previous research (Fisher & Hoisington, 1993). It has been suggested that setting goals may be better understood within an athlete's daily lifestyle, due to the tendency for athletes to be familiar with setting performance goals for competition purposes. Additionally, goal setting may provide a more solid or distinct exercise than other techniques such as imagery or self-talk (Fisher & Hoisington, 1993).

Self-Talk

Compared to the other mental skills training techniques, research on the effects of self-talk and pain perception is sparse. Much discord has surfaced in regards to a unified definition and inclusive elements of self-talk. Self-talk has previously been used to describe an individual's internal dialogue (Theodorakis, Beneca, Malliou, Antoniou, Goudas, Laparidis (1997). This dialogue can either be positive or negative (Tod, Hardy, & Oliver, 2011). Walker and Hudson (2013) propose more inclusive guidelines: (1) it represents verbalizations or statements addressed to the self; (2) it is multidimensional in nature; (3) it has interpretive elements associated with the content of the statements; (4) it is dynamic; (5) it serves a function for the athlete or individual (i.e., instructional or motivational). In the present section, research examining the effects of self-talk on pain and other research outcomes will be outlined.

Within rehabilitation settings, sport medicine physicians indicate a need for the use of self-talk in that it ranks among the most commonly used coping skills by injured athletes (Arvinen-Barrow, Clement, Hamson-Utley, Zakrajsek, Lee, Kamphoff, Lintunen, Hemmings, & Martin, 2015). For instance, athletes that demonstrated a faster healing rate indicated that positive self-talk was among the common uses during rehabilitation (Ievleva & Orlick, 1991). This finding was replicated in a survey of injured athletes from the United States, United Kingdom, and Finland. Those who indicated use of mental skills reported that self-talk was one of the top three mental skills employed during rehabilitation (Arvinen-Barrow et al., 2015). Research on self-talk has been effective because of its ability to create an adaptive positive thinking style in order to minimize pain and improve physical and psychological coping (O'Connor, 1997). In a qualitative study of Olympic wrestlers and figure skaters, athletes stated that they used thought control strategies as a way to cope with their injury (Gould, Eklund, & Jackson, 1993). Furthermore, athletes with season ending injuries, held similar viewpoints (Gould, Udry, Bridges, & Beck, 1997). A couple forms of self-talk have been acknowledged as helpful tools in monitoring individual's internal dialogue: thought stopping, and cognitive reframing (Walker & Huson, 2013). Of the two, cognitive reframing provides a more inclusive and expansive field of research and will be discussed among a variety of populations.

Cognitive reframing can be characterized as a way to challenge cognitions by modifying thoughts and self-statements (Jones, 2003). Researchers have utilized cognitive reframing to help weaken rehabilitation anxieties including anxieties related to experiences of pain (Bull, Albinson, & Shambrook, 1996; Porter, 2003; Syer & Connolly, 1998). Specifically, Ross and Berger (1996) found that positive coping statements and reinforcement statements helped injured athletes reduce pain. Additionally, Naio and Ostrow (2008) created interventions with injured athletes using cognitive restructuring, reading positive statements, and self monitoring to help them recognize and change negative thoughts experienced during the rehabilitation process. At posttest, all athletes indicated that the cognitive intervention helped their physiological and psychological recovery. However, larger uses of cognitive reframing for pain management have been documented in counseling psychology (Arathuzik, 1991; Newth & Delongis, 2004; Sampson & Calvin, 1994; Stevensen, 1995; Watkins, Shifren, Park, & Morrell, 1999). Here, patients with acute and chronic pain benefitted from applying the cognitive reframing technique in order to mitigate feelings of pain.

While self-talk is not well researched within pain research as a whole, it has been shown to be effective in helping build skill acquisition, increase confidence, enhance mood, control anxiety and attention, and increase effort (Bunker & Williams, 1986; Hardy, Jones, & Gould, 1996; Williams & Roepke, 1993). However, experimental studies have presented controversial evidence in reference to the effects of self-talk (Meyers, Schleser, Cooke, & Cuvillier,1979; Palmer, 1992). Most closely related to pain might be the effect that self-talk has on anxiety. There is support that self-talk can have a positive influence on athletes' levels of anxiety and injured athletes' levels of reinjury anxiety or rehabilitation concerns (Hardy, Oliver, & Tod, 2009; Walker, Thatcher, & Lavallee, 2010). While minimal research is available on self- talk techniques in alleviating pain, it is evident that more research is needed to expand previously highlighted effects.

Music

Recent research interests on the ability of music to aid in pain relief have become more prevalent as an adjunct to medicinal pain treatments. Music therapy can be defined as listening to selected music using headphones for the purpose of healing (Buckwalter, Hartsock, & Gaffney, 1985). Numerous studies have suggested that music provides two helpful elements in response to the pain experience. One being the effect on the sensation of pain itself, and two being the emotional responses associated with the pain experience. Thus, music could become a viable alternative when medical treatment is particularly ineffective or when it is not desired by patients (Whipple & Gynn, 1992). Other known associated benefits of music interventions demonstrated throughout research are: music is considered readily available, safe, and a convenient intervention (Cole & LoBiondo, 2014; McCaffrey, 1992; Zimmerman, Pozehl, Duncan, & Schmitz, 1989). Additionally, it has been suggested that three factors combine to effectively offset pain: (1) due to emotional engagement, music provides a larger distraction, (2) self-selection of music provides autonomy throughout a pain intervention, and (3) the active promotion of relaxation throughout the listening experience.

Although research on the effects of music in mitigating pain among athletes has yet to be undertaken, work has been conducted on the beneficial effects of music in helping individuals suffering a variety of pain conditions. The present section will discuss a brief overview of some of the various populations that which the effects of music have produced alleviation of pain.

Music therapy has shown to be effective in decreasing pain among a wide range of medical backgrounds. To name a few: postoperative cancer patients, pregnant women, medical-surgical patients, critical care patients, medical patients, and surgical patients have all benefited from music induced interventions in order to alleviate pain (Cole & LoBiondo, 2014; Ebneshahidi & Mohenseni 2008; Liu, Chang, & Chen, 2010; Lopez-Cepero Andrada et al., 2004; Lukas, 2004; Menegazzi et al., 1991, Sen et al., 2010; Siedlieckı & Good, 2006; Tan, Yowler, Super, & Fratianne, 2010; Vaajoki, Pietila, Kankkunen, & Vehvilainen-Julkunen, 2011; Zımmerman et al., 1989). Among these studies, patients consisted of 1,937 subjects in acute care settings. Music research has also assisted individuals beyond the sufferings of acute pain.

More recently, health care providers have recognized that individuals with chronic pain can benefit from interventions that can address the psychological as well as the physiological components of controlling on going pain (Leao & Silva, 2005; Magill, 2001; McCaffrey & Freeman, 2003). Leao and Silva (2005) investigated patients with chronic musculoskeletal pain. Chronic pain can cause deleterious effects towards an individuals quality of life, functioning, and independence. Within this study, female patients with Fibromyalgia, repetitive strain injuries, and spinal column diseases were split into three groups and each listened to three classical music pieces. Patients were asked to report their pain prior to listening to music and after listening to music. Following the conclusion of the study, each group experienced a significant reduction of pain perception. This finding is reinforced across both chronic pain and acute pain studies (Beck, 1991; Good, Staton-Hicks, Grass, Anderson, Lai, Roykulcharoen, & Adler, 2001; Voss, Good, Yates, Baun, Thompson, & Hertzog, 2004; White, 2001).

Most closely related to sport, two studies have been conducted examining music and pain in a physical therapy setting (Bellieni et al., 2013; Ferguson & Voll, 2014). However, within the rehabilitation setting, research shows a confliction in evidence. For instance, Bellieni et al., (2013) examined the effects of self-selected music on pain perception during a single physical therapy session. Results from their repeated measures design revealed that patients reported having lower ratings of pain after therapy sessions with music compared to therapy sessions without music. However, range of motion during physical therapy with burn patients provided no significant reduction in pain during the music sessions (Ferguson & Voll, 2014).

We have seen repeatedly throughout research that pairing psychological skills techniques together typically has a stronger impact on desired outcomes in both athletic and nonathletic populations (Alden, Dale, & Degood, 2001; Azevedo & Samulski, 2003; Brewer, Jeffers, Petipas, & Van Raalte, 1994; Cupal & Brewer, 2001; Dreidiger, Hall, &

Callow, 2006; Durso-Cupal, 1996; Ievleva & Orlick, 1991; Johnson, 2000; May & Brown, 1989; Nicol, 1993; Potter & Grove, 1999; Reese, Pittsinger, & Yang, 2012; Sthalekar, 1993). Similarly, despite variability in pain reduction among certain populations, researchers have shown that when music is complemented with another mental skill, (i.e., imagery, relaxation) it has demonstrated to be efficacious in pain treatment (Good et al., 2001; Leao & Silva, 2005; Tusek, Church, & Fazio, 1997).

Collectively, the aforementioned studies suggest that music and other pain management techniques have beneficial effects for pain reduction among individuals suffering a host of physical conditions and ailments. Yet, improvements in the methodology of music research can still benefit the field.

Directions for Further Research

Given the absence of research on music and pain management with athletes, this section provides ideas for further research in this area. Despite the positive progress made, using music as an analgesic for populations experiencing pain still has the ability to expand. Music therapy has been employed in a broad spectrum of clinical conditions, yet detailed and concrete results are lacking within the field. Mitchell and Macdonald (2009) suggest that research on music might benefit from a stronger structure as well as standardized methodology in attempt to remedy ambiguity between research studies. One additional aim, echoed by multiple researchers is the attempt to be more theoretically based with current research (Beck, 1991; Good et al., 1999; Perlini & Viita, 1996). Theoretical grounding provides more than an historical context with which to frame research, it also provides a more narrowed and polished approach to view future research questions. A theoretical framework may provide some cohesion between current music research, which currently lacks structure in similarities.

While I have discussed the effects of music reducing pain in a number of populations, previous music and pain management literature has little presence among athletes. Of the few studies examining music and pain in a related field of physical therapy, none have examined the benefits of music for managing pain in relation to an isolated treatment modality – for example, a single icing session. Rather, researchers have examined the effects of music for pain experienced over the course of an entire physical therapy session (e.g., Bellieni et al., 2013). Although, researchers have discussed the opportunity to implement a music intervention with athletes in order to combat feelings of pain. For example, Holden and Holden (2012) discuss how music can act as a painkiller by releasing the body's endorphins, thus facilitating a pain relieving response, which can be an effective treatment technique for athletes who experience pain. Additionally, Saalfield (2008) is a strong proponent of purposeful implementation of music into the athletic training room. He argues that adding music can have beneficial implication for an athlete's mood and motivation as well as masking feelings of discomfort. Furthermore, research justifies using music as an intervention because athletes are already using it for purposes such as increased motivation, emotion regulation, and relaxation; therefore, providing an easily implementable technique (Lane, Davis, & Devonport, 2011; Laukka & Quick, 2011).

Given the absence of research examining the effects of music for pain management in an athletic population and the potential benefits of music for pain management during a commonly employed painful therapeutic treatment (i.e., icing), a practical and/or applied intervention may be relevant. Therefore, the purpose of this study is to examine the effect of a music intervention on ice-related pain with division I college athletes.

APPENDIX B

REFERENCES FOR EXTENDED

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